

REMARKS

Applicant thanks the Examiner for the thorough examination of the application.

Status Of The Claims

Claims 1-7, 11, 13-16, 20-24 and 28-35 are now present in the application. Claims 1, 22, 30 and 31 are independent claims. By this Amendment, claims 1, 22, 30, 32, 33 and 34 are amended, and claims 32-35 are added. No new matter is involved.

Reconsideration of this Application, as amended, is respectfully requested.

Personal Interview

Applicant acknowledges with appreciation the courtesies extended by Examiner Wilson to their representative. Mr. Robert J. Webster, Reg. No. 46,472, during the personal interview conducted on June 30, 2009. During that interview, Examiner Wilson agreed that the claims appear to patentably define over the applied art.

Examiner Wilson also agreed that the status of the outstanding Office Action is a non-final Office Action.

Rejections Under 35 U.S.C. § 103

Claims 1, 2, 5-7, 11, 13, 15, 16, 20-21, 30 and 31 stand rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,771,110 to Hirano et. al. (Hirano) in view of U.S. Patent No. 6,133,145 to Chen (Chen). Claims 10, 17-19 and 25-27 stand rejected over Hirano and Chen and further in view of U.S. Patent No. 6, 583,065 to Williams et al. (Williams). Claims 3, 4, 14, 23, 24, 28 and

29 stand rejected over Hirano and Chen and further in view of JP 361002368 to Muraguchi et al. (Muraguchi). These rejections are respectfully traversed.

Independent claim 1, as amended, positively recites a combination of features, including treating the exposed portion of said metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the exposed portion of said metal layer; and etching the treated portion of said metal layer to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and treating the exposed portion of said metal layer are sequentially performed.

Independent claim 22, as amended, positively recites a combination of features, including exposing the uncovered portion of said metal layer to a first plasma, prior to any step of etching said metal layer, to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the uncovered portion; and etching the uncovered portion of said metal layer with a second plasma to form a metal pattern, wherein said depositing a metal layer over a substrate, forming a mask on a surface of the metal layer, and exposing the uncovered portion of said metal layer are sequentially performed.

Independent claim 30, as amended, recites a combination of features, including exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching said photoresist pattern and prior to any step of etching said metal layer, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and etching the uncovered portion of said metal layer with at least one second gas to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a

photoresist pattern, and exposing the uncovered portion of said metal layer are sequentially performed.

Independent claim 31 recites a combination of features, including exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and etching the uncovered portion of said metal layer with at least one second gas to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and exposing the uncovered portion of said metal layer are sequentially performed, wherein the second gas includes a composition of HBr plasma gas and Cl₂ plasma gas or a composition of HBr plasma gas and CH₄ plasma gas.

Applicant respectfully submits that the two references applied in this rejection teach away from being combined, as suggested, for a number of reasons.

Firstly, Hirano's pixel electrode is formed by sputtering a layer of ITO and/or IZO, patterning it with a photoresist, and etching the photo resist. See steps 14 and 15 as described in col. 12, lines 48-60. Hirano's pixel pitch is disclosed to be 50 microns by 150 microns, as described in col. 16, lines 23-29.

Chen, the secondary reference applied in these rejections, discloses various ways to slow the etch rate of a photoresist when fabricating aluminum interconnect structures. According to Chen, the prior art hardened photoresists to slow the photo resist etch rate. See, for example, col. 1. lines 35-40. Chen, however, describes "a plasma treatment, in a nitrogen containing ambient, applied to the photoresist shape prior to the metal etch cycle in a specific

etchant while maintaining the desired removal rate of the exposed metal.” Col. 1, lines 32-35.

Applicant notes that Chen does *not* speed up the etch rate of the metal.

Accordingly, neither of these two references contains a disclosure of the claimed invention, which recites, (in claim 1) treating the exposed portion of said metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the exposed portion of said metal layer; (in claim 22) exposing the uncovered portion of said metal layer to a first plasma, prior to any step of etching said metal layer, to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; (in claim 30) exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching said photoresist pattern and prior to any step of etching said metal layer, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and (in claim 31) exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer.

Chan clearly discloses applying a plasma, not to the metal structure under its photoresist, but to the photoresist to decrease the etch rate of the photoresist while “maintaining rate desired removal rate of the desired metal,” (col. 1, lines 32-35), which is completely different from the claimed invention, in which the uncovered portion of said metal layer is exposed to a first plasma, prior to any step of etching said metal layer, to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the uncovered portion.

Because neither applied reference discloses the claimed invention, logically, no matter how they are combined, they cannot possibly disclose, suggest, or otherwise render obvious, the claimed invention.

Turning to Williams, the tertiary reference used in the rejection of the claims which recite specific etchant materials and ratios of etchant materials, Applicant respectfully submits that Chen's disclosure is with respect to "a specific etchant" (col. 1, line33-34), and that Williams uses a different etchant that that claimed with specific metal layers, which contain plural different metals, including titanium, titanium nitride and aluminum. Accordingly, Applicant respectfully submits that the Office Action does not make out a prima facie case of proper motivation by one of ordinary skill in the art to turn to Williams to modify Chen to arrive at the claimed etchant materials, in general, or in the ratios claimed.

With respect to the rejection of claims 3, 4, 14, 23, 24, 28 and 29, which is based, in part on Maraguchi, Maraguchi clearly does not disclose using a hydrogen plasma treatment of a thin film transistor pixel electrode, or any semiconductor device metal electrode, with reactive hydrogen to increase the subsequent etch rate of exposed metal, as claimed. Instead, as pointed out during the aforementioned interview, Maraguchi is limited to removing oxygen atoms in a GaAs semiconductor device to improve device performance as shown, for example, in Table I, which concerns parameters other than increasing subsequent etch rate of exposed metal.

Accordingly, even if one of ordinary skill in the art were properly motivated to modify Hirano and Chan, as suggested (with respect to which proper motivation has not been demonstrated), the resulting modified version of Hirano-Chen would still not disclose, suggest, or otherwise render obvious, the claimed invention.

During the interview, Applicant's representative pointed out that all language in the claims is entitled to patentable weight, including the functional language that the outstanding Office Action is an intended use limitation, at least because the claims in issue are methods claims, not article claims. Examiner Wilson appeared to agree with this position.

Applicant has also, in certain independent claims, rearranged "thereby lowering an internal binding force in the exposed portion of said metal layer to increase a subsequent etch rate of said metal layer; to read - - to increase a subsequent etch rate of said metal layer by lowering an internal binding force in the exposed portion of said metal layer - - to address this "patentable weight" issue without narrowing the scope of the claim.

Accordingly, Applicant respectfully submits that the claimed invention clearly patentably defines over the applied art, a conclusion with which Examiner Wilson agreed during the aforementioned interview.

Reconsideration and withdrawal of this rejection are respectfully requested.

Conclusion

Applicant considers all of the Examiner's comments to have been addressed and all of the Examiner's rejections overcome, thereby placing all claims pending in the present Application in condition for allowance. Accordingly, a Notice of Allowability is solicited in earnest.

Should there be any outstanding matters that need to be resolved in the present Application, the Examiner is respectfully requested to contact Robert J. Webster, Reg. No. 46,472, at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Reply to April 1, 2009 Office Action

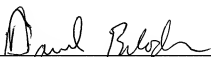
Appl. No. 09/648,111
Atty. Docket: 3430-0131P
Group: 2815

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

Dated: June 1, 2009

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By 

Esther H. Chong
Reg. No. 40,953
BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road, Suite 100 East
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

DAVID A. BILODEAU
USPTO #42,325